Thermal Analyses - 13 CCD FPA Cassegrain Optics

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Objectives - FPA Model

- Evaluate new FPA thermal design
- Validate appropriate radiator size
- Evaluate effect of FPA window coating/baffling
- Determine impact of specular heat exchange

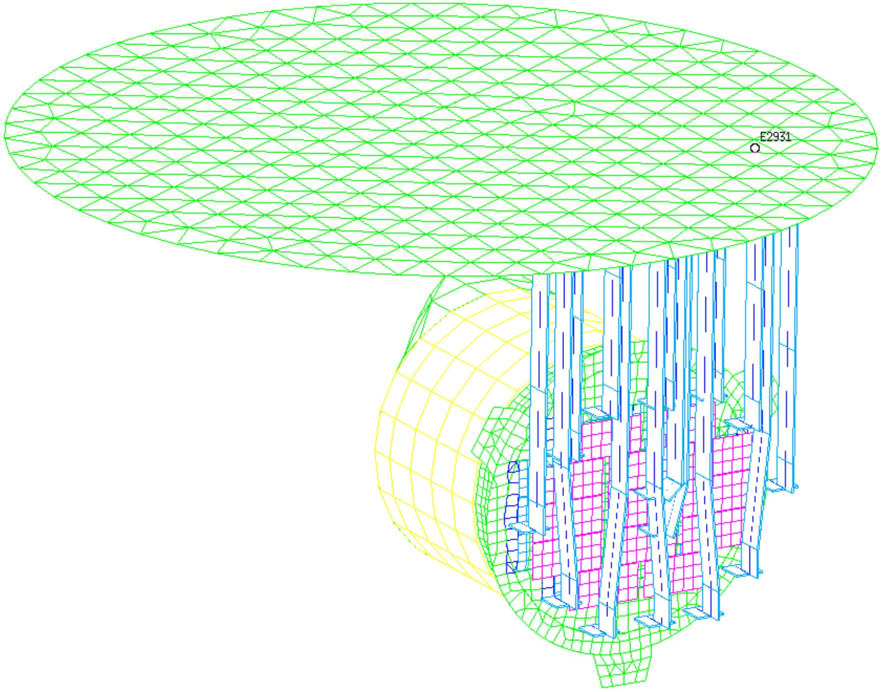
Requirements

Requirement:	Derivation:
Maximum CCD operating temp. = -80 °C	CCD EOL charge transfer efficiency
Maximum FPA window temp. gradient = 10 °C (TBD)	Optics lateral color
*FPA bulk temp. stability = ±0.08 °C over 10 minutes	1/350 pixel lateral motion on CCDs

*changed to reflect smaller FPA

Detailed FPA Thermal Model

- Total number of elements = 2953
  - 523 baseplate
  - 416 CCDs
  - 623 radiator
- Steady state analysis with orbital heating on radiator
- 25% design margin on electrical heat load
  - 3.25 W CCD
  - 5.55 W filter board
- Radiator size = 0.42 m^2



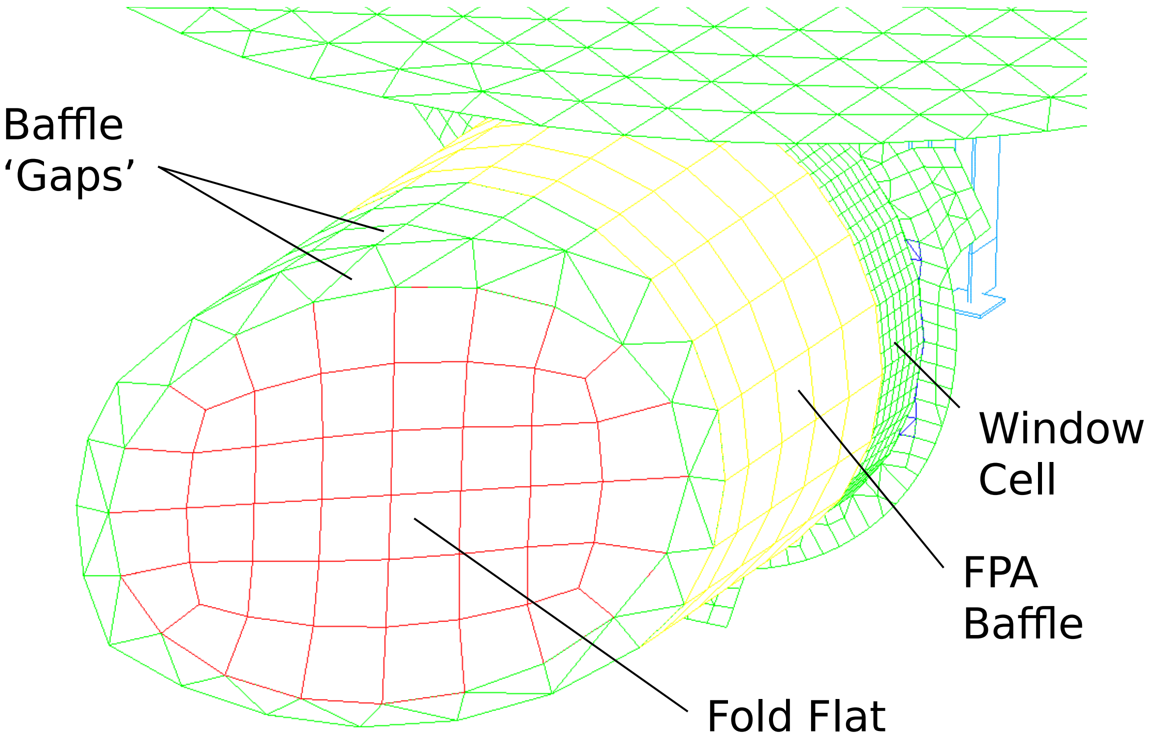
Detailed FPA Thermal Model - Results

- Operating temperature requirement easier to meet due to reduced heat loads
- Elimination of FPA window coating has a substantial effect - heat load increase of ~ 5-6 W without reflective baffling
- Specular heat transfer (fold flat) increases heat gain from warm lens assembly by ~4-5x over diffuse, but heat load is likely smaller than baffling loads*
- Window loads can be mitigated by reflective baffling
- Baseline radiator size = 0.55 m^2

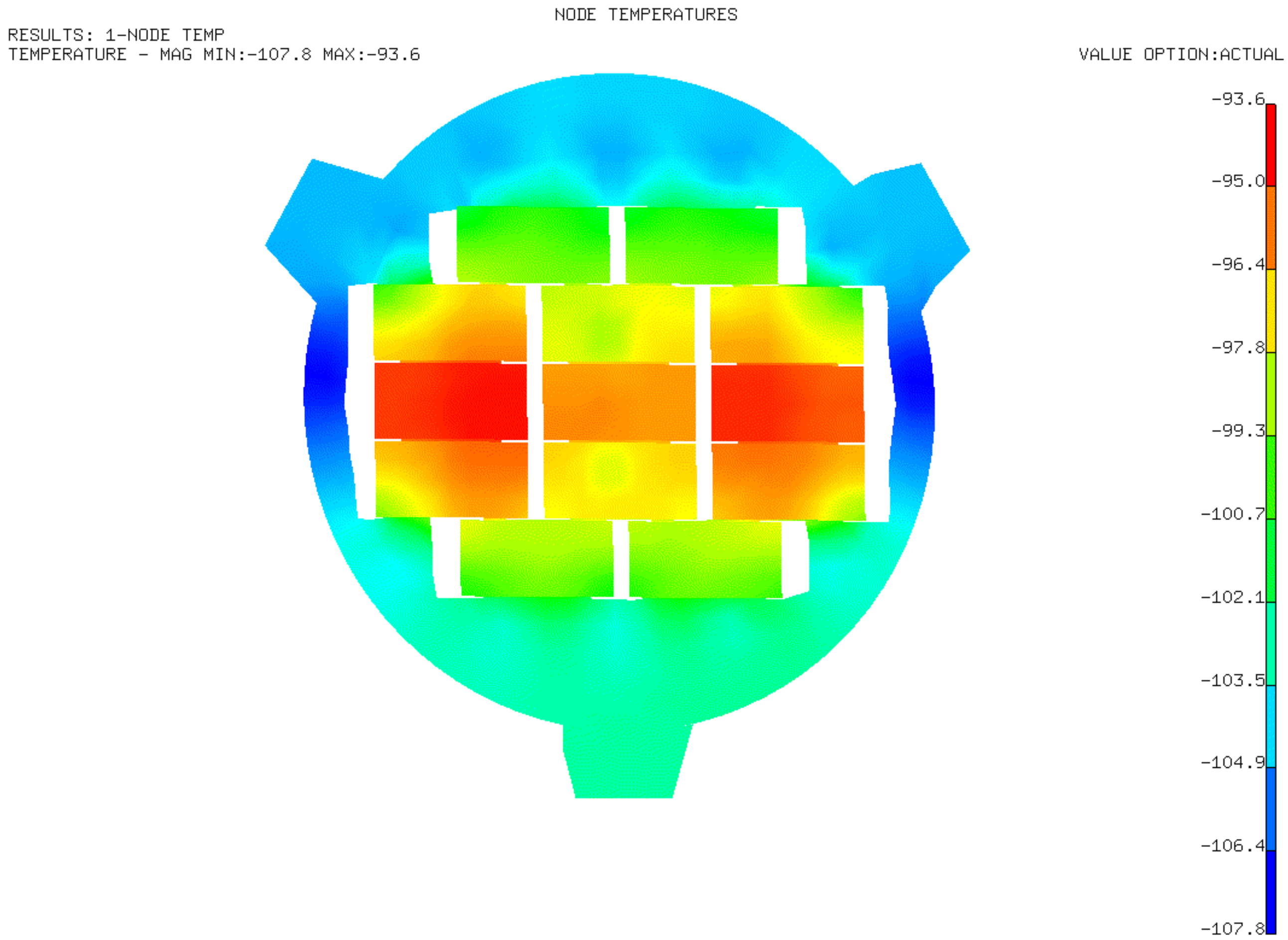
*analyses performed with separate TSS radiation exchange model

Detailed FPA Thermal Model - Baffling Sensitivity Study

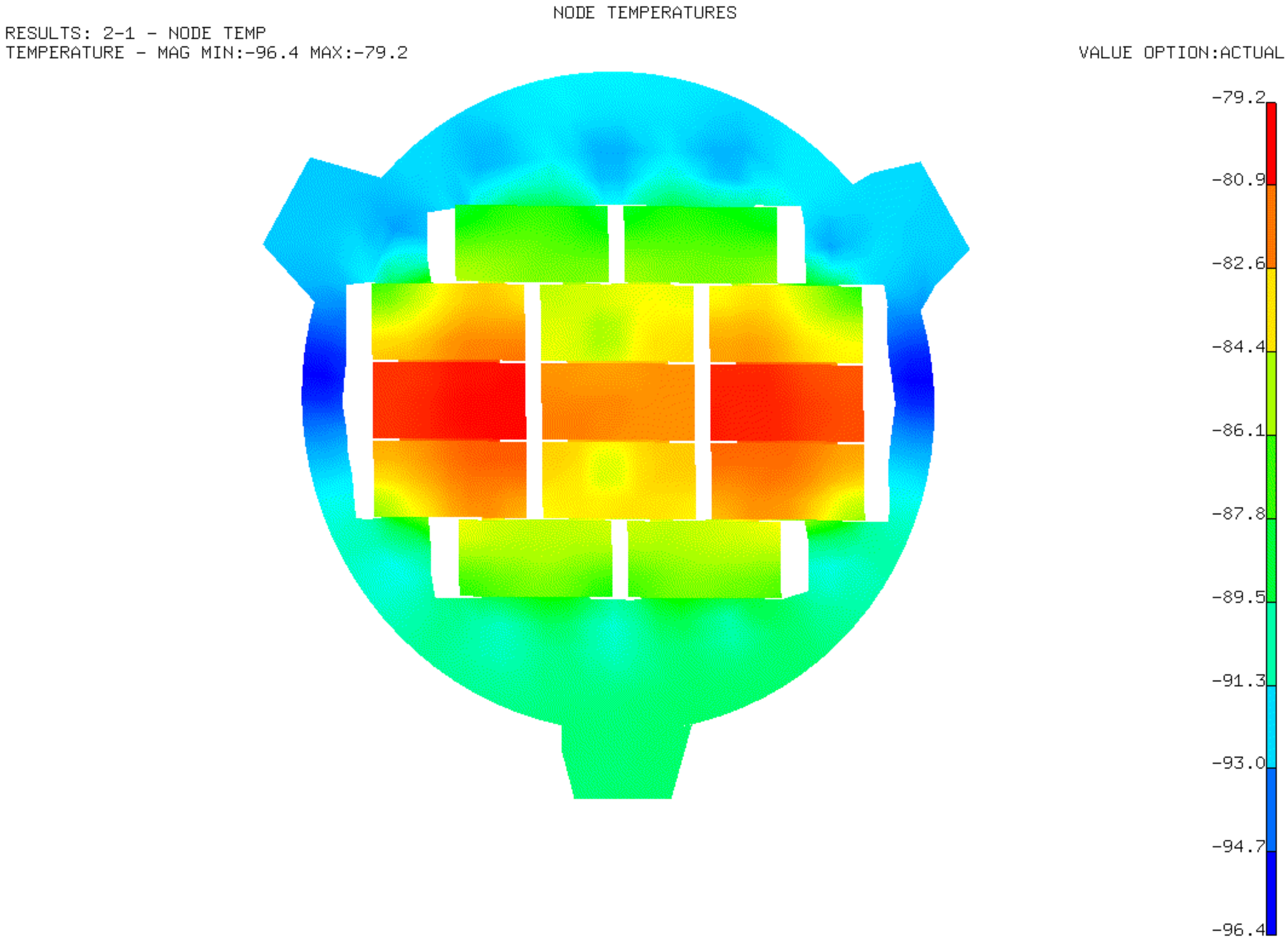
- Uncoated window sensitive to baffle surfaces
- Looked at various levels of reflective surfaces on baffle and 'gaps' around fold mirror



Detailed FPA Thermal Model - Shiny Baffle/Gaps



Detailed FPA Thermal Model - Black Baffle/Gaps



Objectives - Optics Analyses

- Evaluate thermal design for lens assembly
- Evaluate overall optics temperature distribution
- Evaluate compound mirror assembly thermal stability
- Determine impact of black-coated aperture stop on compound mirrors

Status - Optics Analyses

- Completed optimization of routines for simulation of proportional heater control
- Starting transient runs with full instrument/spacecraft orbital model
- Determined modifications and additional detail required for evaluation of optics temperature distribution
- Received NRL spacecraft thermal model, starting to reconcile with LM model
- Performed analyses with detailed compound mirror model and simulated aperture boundary conditions to evaluate aperture stop